(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 226 324
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 86308731.8

(22) Date of filing: 10.11.86

(51) Int. Cl.⁴: F23D 14/14 , F24C 15/24 , F24C 3/08

(30) Priority: 08.11.85 GB 8527595
26.08.86 GB 8620606

(43) Date of publication of application:
24.06.87 Bulletin 87/26

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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(54) Surface combustion radiant.

(57) A radiant (1), for a self-aerating burner, having a multiplicity of ports (12) passing gas/air mixture for combustion at the surface of the radiant, wherein the ports are provided in discrete areas (11) that alternate with raised non-ported bars (10) with angled flanks which in use receive impingement of flame, giving visible radiation from the flanks but not the tops of the bars.

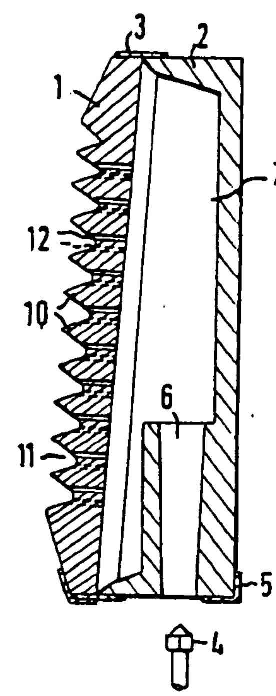

FIG.1

EP 0 226 324 A1

SURFACE COMBUSTION RADIANT

The invention relates to surface combustion radiants and self-aerating burners using them.

The invention provides a radiant, for a self-aerating burner, having a multiplicity of ports passing gas/air mixture for combustion at the surface of the radiant, wherein the ports are provided in discrete areas that alternate with raised non-ported bars with angled flanks which in use receive impingement of flame, giving visible radiation from the flanks but not the tops of the bars. Suitably the ported areas as seen in plan occupy 30 to 70%, conveniently 30 to 50%, of the area of the radiant.

The invention extends to self-aerating burners using the radiants, mounted to be fed with gas/air mixture from a plenum chamber itself fed by a gas injector jet inducing combustion air in per se known way, and to radiant heaters, particularly domestic gas fires, hobs or grills, incorporating such burners.

It should be noted that the area of the radiant as referred to in the description and claims is the area in plan, and that the ported areas are regarded as defined by straight or smoothly curved lines drawn grazing successive ports adjacent to the bars. The bars are conveniently continuous, broken only if desired by a lighting groove connecting the ported areas so that they do not have to be lit individually. However the use of bars divided into sections is not excluded, provided they retain the characteristic of having angled, radiating flanks and a dark, i.e. not visibly radiating top.

In a preferred form, assisting stable combustion, the ports are in the form of multiple adjacent lines of holes, two or more lines to each ported area. Further, heat output is improved if those holes adjacent to the bars are in part formed to run into the flanks of the bars so flame plays directly on the flanks.

The application of the new radiants is primarily in the domestic context whether in gas fires or for example in hobs or grill units, where conventional surface combustion radiants giving intensive heat over small areas are unsuitable. Tests of gas fire radiants, of equivalent size to conventional radiants heated by separate gas jets, and thus constituting straight replacements for such radiants in terms of gas fire design, have for example shown not merely a suitable heat output but a major and unexpected improvement in efficiency. At full fire, overall heat output related to gas used has been found typically improved by 5%, and radiant output by 30% or more. The radiant output is particularly significant, in that perceived comfort depends only partly on air temperature. Direct radiant heating is desirable as well and conventional radiants are often deficient in this respect, especially at low fire.

The angle made by the flanks of the bars to the general plane of a radiant is determined for optimum radiant output, neither so upright as to constrict the burning mixture at the ports nor so shallow as not to be effectively impinged on by the flame. A suitable radiant for use in a domestic gas fire is for example one wherein the bars run across the radiant and the upper flank of each bar forms a shallower included angle to a normal to the plane of the radiant than the lower side does, for example angles respectively within the ranges 10° to 40° and 20° to 60°. For use flat, as in a grill or hob, the angles are suitable equal, for example within the range 15° to 55°.

The port sizes are in themselves conventional for surface combustion radiants, depending on the fuel gas for which the radiant is designed and its supply pressure, for example holes of 1.1 diameter up to 1.6mm for hydrogen rich (1st family) gases such as town (coal) gas, 1.1 up to 1.8mm for methane rich (2nd family) gases such as mains natural gas, and 1.1 up to 2mm for 3rd family gases such as LPG (liquified petroleum gases, bottled gas) all at the usual supply pressures.

The radiants may be glazed, coloured or other surface coatings applied if desired, to reduce friability of radiants made of bonded fibre and/or to give special effects. In particular a grill radiant may be coloured black, giving somewhat longer wave length radiation with improved performance.

Thus the new radiants conveniently reduce the heat output of a radiant, per unit area, to a figure convenient for domestic use and in particular compatible with conventional gas fire design. The radiants become effective replacements for traditional gas fire elements heated by impingement of flame from separate burners.

Specifically, domestic gas fires have for many years been constructed to allow gas flames from a burner to impinge on radiants which then glow and radiate heat and light. The gaseous products of combustion, after passing through, or in some cases over, the radiant structure, are then either conveyed directly by means of a flue to the outside of a building ('radiant only' fires) or, in many cases, passed through a heat exchanger ('radiant convector' fires) so that a proportion of the residual heat can be extracted and passed into the room. The cooled products of combustion and excess air are then passed outside the building.

In this application of the present invention, we aim to improve the overall radiant performance and at the same time reduce the cost of manufacture of a gas fire by combining the gas burner and radiant

into one component; we have also attempted, most carefully, to maintain a traditional appearance to the new radiant, since this is considered desirable aesthetically, although not functionally necessary.

Further, all domestic gas fires must in practice be able to operate on both maximum and very much reduced gas inputs since maintaining correct room temperature needs much less heat output than the initial heating up of the room. The reduced heat output can be achieved by reducing the amount of gas supplied to all of a set of radiants equally. This, however, quickly eliminates the radiant glow since the reduced gas flame does not impinge throughout the full height of the radiant. This is particularly so with the radiant convector type since the heat exchanger alone can easily supply sufficient heat; thus the appearance of the fire when turned down is much inferior. By using separate gas supplies to individual radiants they can, in turn, be extinguished until the correct heat output is achieved but as the radiants are arranged side by side this can only be carried out by reducing the width of the heated area. This, in turn, greatly reduces the efficiency of the customary type of heat exchanger, since it extends across the width of the fire and only a small proportion of it will be heated.

With the new radiant burners it is readily possible to reduce the heated area in vertically-successive parts, so that the full width of heat exchangers is kept in use when the fire is operating at reduced output.

We have also as noted above achieved success in improving heat output, tests showing 30% more radiant output when comparing conventional ceramic radiant and separate burner construction, as used in gas fires, with a combined radiant and burner of the same size and gas input made according to the invention.

A relatively smaller but useful gain in overall heat efficiency of 5% has also been found when converting existing designs of fire to use the new burner. This gain may be increased by optimising the design of the fire heat exchanger to suit the gas flow volume and temperatures produced by the new burner.

We have further found that the new radiant heats up in a shorter period than previous constructions and maintains a much improved radiant heat output and good luminous appearance when operating under reduced gas input rate. Moreover, emission of carbon monoxide when the burner is operating under conditions of reduced oxygen supply, such as could be caused by a blocked flue or inadequate room ventilation for instance, is at a level accepted as non-injurious to health.

A quite separate application of the invention concerns gas cookers, in for example grills and particularly in hobs such as the kind in which a radiant lies below a protective heat-transparent plate, usually of glass ceramic. The heat output per unit area of the new burners is well suited to such applications, and more particularly there is the advantage that if the bars of a hob are essentially as concentric rings the burner area can be suited to pan size and/or to different classes of cooking, simply by having separate gas/air supplies to successive concentric zones of the radiant.

This new radiant when compared to previous usage of surface combustion radiants in cooker hobs shows similar advantages to the gas fire application but of particular importance is the controllability of the burner enabling the radiating area to be adjusted to match both the size of the pan in use and the heat input desired.

Embodiments are schematically illustrated by way of example in the accompanying drawings, in which:-

Fig. 1 shows an all-ceramic burner unit in vertical cross-section;

Fig. 2 shows such a unit in perspective;

Fig. 3a shows a vertical cross-section of and Fig. 3b a front view of a small part of a burner plaque or radiant forming the front of such a unit;

Fig. 4 shows an overall view of a burner unit divided in vertically successive sections;

Fig. 5 shows an exploded view of a burner unit with a steel case, divided in laterally separate sections;

Fig. 6 shows a section of the unit of Fig. 5;

Fig. 7 shows a rear view of a further radiant with central ports of a lighting groove;

Fig. 8 shows a hob burner radiant in plan;

Fig. 9 shows the hob burner assembly including the radiants, in diametral section;

Fig. 10 shows the plenum chamber and gas supply of the assembly in plan; and

Fig. 11 shows the plenum chamber in side view.

In Figs. 1 to 7 of the drawings a burner radiant or plaque is indicated at 1 and a box or case 2 forming a plenum chamber, impregnated tape 3 joining them. Conventional bonded fibre (U.K. Patent No. 1 436 842) or radiant clay may be used for the plaque, and clay or steel for example for the box or case. The rest of the fire is conventional and not shown apart from a schematically indicated support frame 5 (Fig. 1) and gas jets 4. Formed integrally with or fixed into the box or case are one or more venturis 6 for the jets 4, conventional in themselves.

All the fires use similar plaques fed from a plenum chamber 7, unitary as in Fig. 1 or divided into several separate sections with individually controlled gas jets, horizontally as indicated at 8 in Fig. 4 or vertically as in Fig. 5 by partitions 9. The plaques are divided into bars 10 and ported areas 11 with holes 12 for passage of the gas/air mixture. The holes are staggered in two rows and are at 3mm centres in the rows and 3mm row spacing, again on hole-centres. The bar spacing ridge to ridge is 12mm with a 2mm wide flat channel between bars, so the hole centres are actually in the flanks of the bars. The included angles between a normal to the plane of the radiant and the faces or flanks of the bars are 18° (upper flank) and 32° (lower flank), though these angles are only generally represented in the drawings.

A lighting groove (unreferenced) is indicated in Fig. 4 centrally of the radiant and shown at the left of Fig. 3, and is in fact conveniently provided in all the designs, with an appropriate ignitor of conventional kind.

The details of heat exchangers are not shown as they are conventional, an advantage and indeed a considerable part of the point of the new units being that they can be used in existing gas fire designs as a straight replacement for the whole gas-supply/radiant assembly. Heat is produced over the sort of area people are used to and like, rather than in concentrated small areas such as surface combustion plaques give in uses when concentrated heat is required. The fire can be turned down without substantial loss in the glow, particularly in the designs where the plenum chamber is divided into sections. Designs such as those of Fig. 4 with horizontal division of the plenum chamber preserve the efficiency of heat exchange even at part fire.

The radiant burner may be produced in several ways for instance (Figs. 1 and 2) with a "Tennaglo" (Trade Mark) bonded ceramic fibre radiant or plaque, made by filter casting, as the front face, and a pressed clay burner box. The two may be held together by glass fibre tape and fire resistant cement.

An example of the "Tennaglo" material made as for example disclosed in detail in U.K. Patent 1 436 842 referred to above by vacuum casting on a shaped former, the casting material being a slurry of ceramic fibre with a bonding agent.

The fibre is an alumino-silicate material made from fused kaolin and has the following properties:-
Melting point 1760°C
Continuous Service Temperature 1260°C
Fibre Diameter, average 2.8 microns

Analysis:

Alumina, Al_2O_3 45.1%
Silica, SiO_2 51.9
Iron Oxide, Fe_2O_3 1.3
Titania, TiO_2 1.7
Magnesia, MgO Trace
Calcium Oxide, CaO 0.1
Alkalies as Na_2O 0.2
Boric anhydride B_2O_3 0.08

The slurry is made from 5 parts by weight of fibre, having lengths of about 15cm to 25cm, with two parts by weight of ball clay and 0.1 parts by weight of tricalcium phosphate flux as bonding agent. The ingredients are mixed together in a chopper mixer so as to produce a slurry in which the fibre lengths are for the most part between 0.025 and 1.25cm in length.

The vacuum casting gives a soft, pliable green shape which is dried at 150°C and then fired in air at about 1050°C for half an hour, sufficient to bond the fibres.

Alternatively, the radiant may be made of a traditional radiant clay, for example:-
China Clay 39%
Ball Clay 20%
Fused Silica 30%
Wood Flour 10%
Bentonite 1%

An example of a ceramic box clay body is:-
China Clay 39%
Ball Clay 20%
Molochite 30%
Wood Flour 10%
Bentonite 1%

Referring to the gas hob assembly of Figs. 8 to 11, the radiant itself as seen in Fig. 8 has concentric ring-form bars each in four segments. The bars are referenced 21 (Fig. 9) and the ported areas between them 22. The radiant is held in a die cast metal base 23 by a bezel 24. An ignitor 25 is disposed centrally and flame from it travels through the radial gaps 26 between the bar segments. A plenum chamber formed by the base 23 is divided into four sections 27, as seen in Fig. 10 particularly, with venturis 28 and individual gas jets one of which is referenced 29. These gas jets are individually controlled in per se conventional manner at 30. The gas jets induce the air supply into the plenum chamber for passage of gas/air mixture through the part of the plaque supplied for combustion between the bars.

All heat outputs between simmering and full heating for a large pan are provided for, the inner plenum section being small and the outer one large, with two intermediate sized ones between, and the gas supply being individually controllable to a given section.

Claims

1. A radiant, for a self-aerating burner, having a multiplicity of ports passing gas/air mixture for combustion at the surface of the radiant, wherein the ports are provided in discrete areas that alternate with raised non-ported bars with angled flanks which in use receive impingement of flame, giving visible radiation from the flanks but not the tops of the bars.

2. A radiant according to claim 1, wherein the ported areas as seen in plan occupy 30 to 70%, conveniently 30 to 50%, of the area of the radiant.

3. A radiant according to claim 1 or 2, wherein the ports are in the form of multiple adjacent lines of holes.

4. A radiant according to claim 3, wherein the holes adjacent to the bars are in part formed to run into the flanks.

5. A radiant according to any preceding claim, for use upright is a domestic gas fire, wherein the bars run across the radiant and the upper flank of each bar forms a shallower included angle with a normal to the plane of the radiant than the lower side does.

6. A radiant according to any of claims 1 to 4, for use in a hob, wherein the bars are in the form of concentric rings.

7. A radiant according to any preceding claim, for use with a divided plenum chamber allowing successive sections of the radiant to be independently supplied with gas/air mixture.

8. A radiant according to claim 7, for use upright in a radiant convector domestic gas fire, in which the plenum chamber divisions are horizontally disposed so that a full-width heat exchanger in the fire operates across its whole width even at part fire with not all said sections in use.

9. A radiant according to any preceding claim with a channel dividing the bars to allow a single ignitor to light all the ported areas.

10. A radiant according to any preceding claim when incorporated in a self-aerating burner.

11. A radiant heater, particularly a domestic gas fire, hob or grill incorporating a burner according to claim 10.

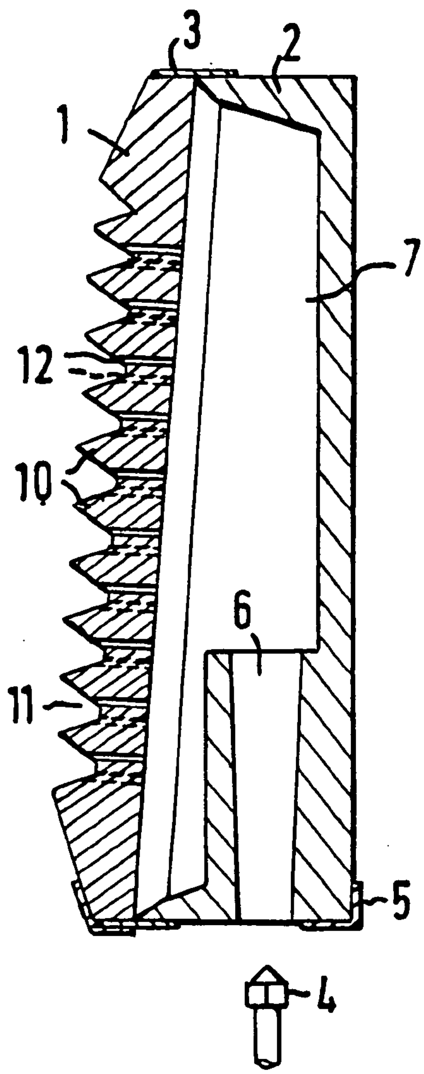

FIG.1

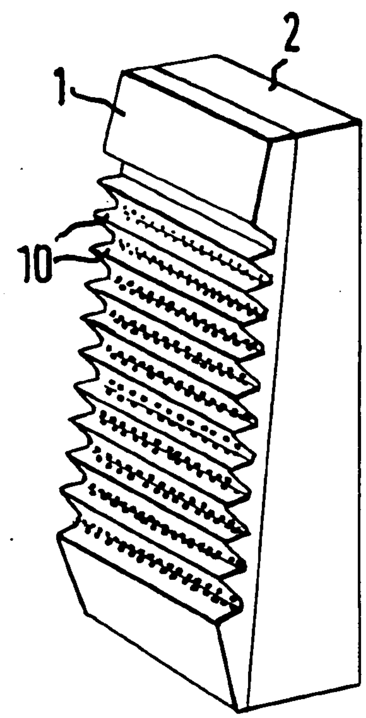

FIG. 2

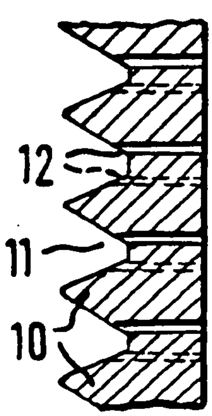

FIG.3a

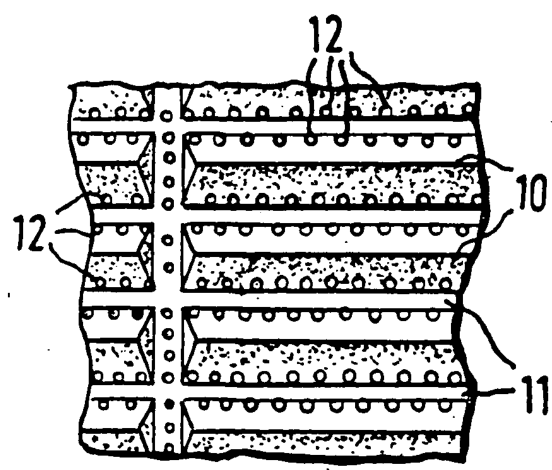

FIG.3b

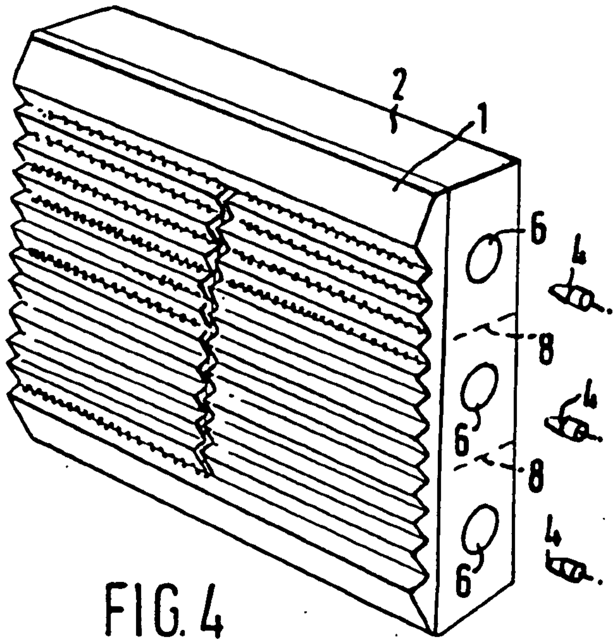

FIG. 4

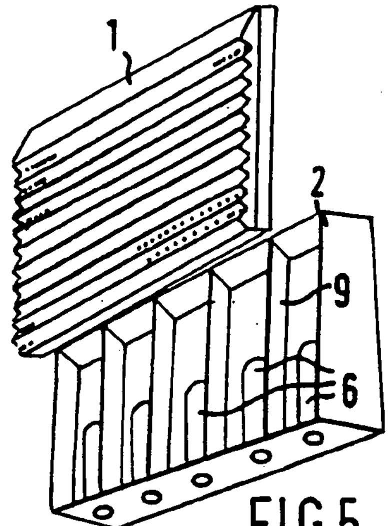

FIG 5

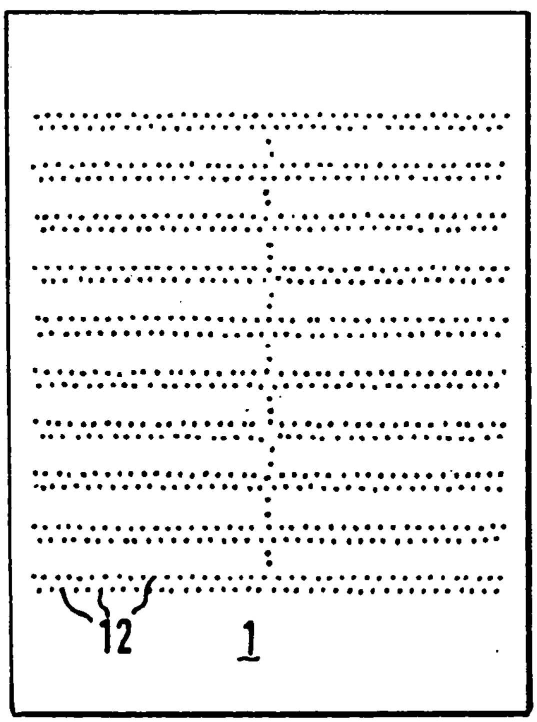

FIG.7

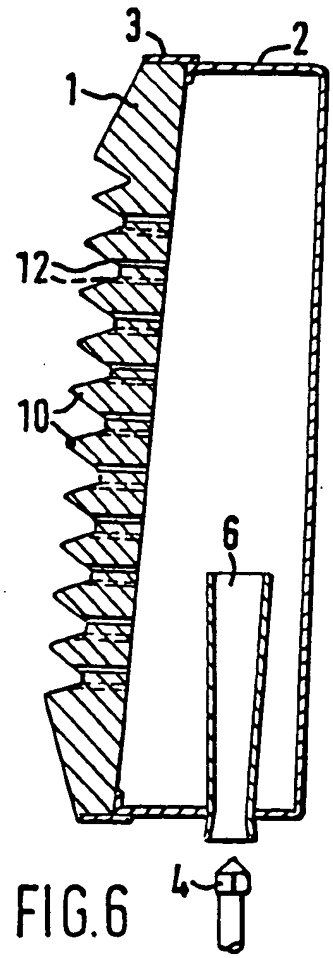

FIG.6

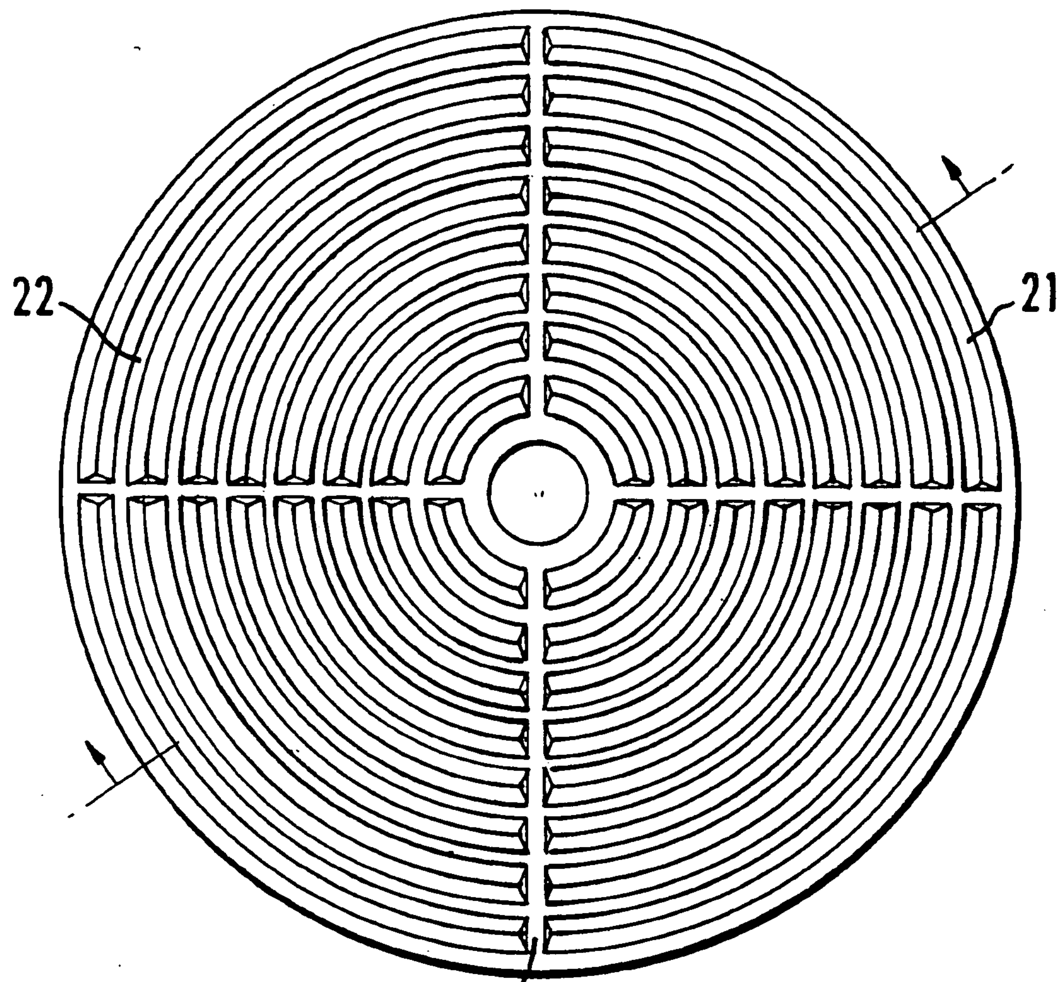

FIG. 8

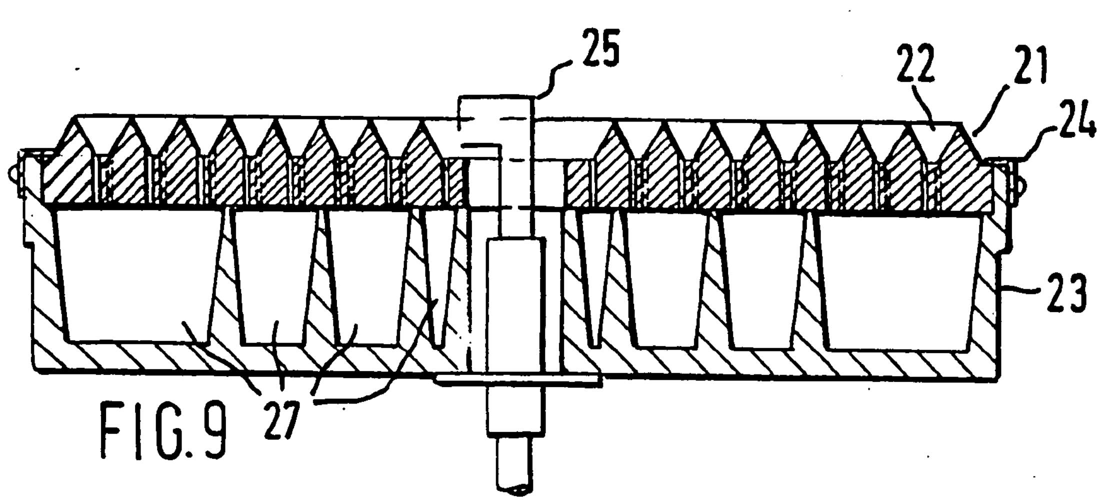

FIG. 9

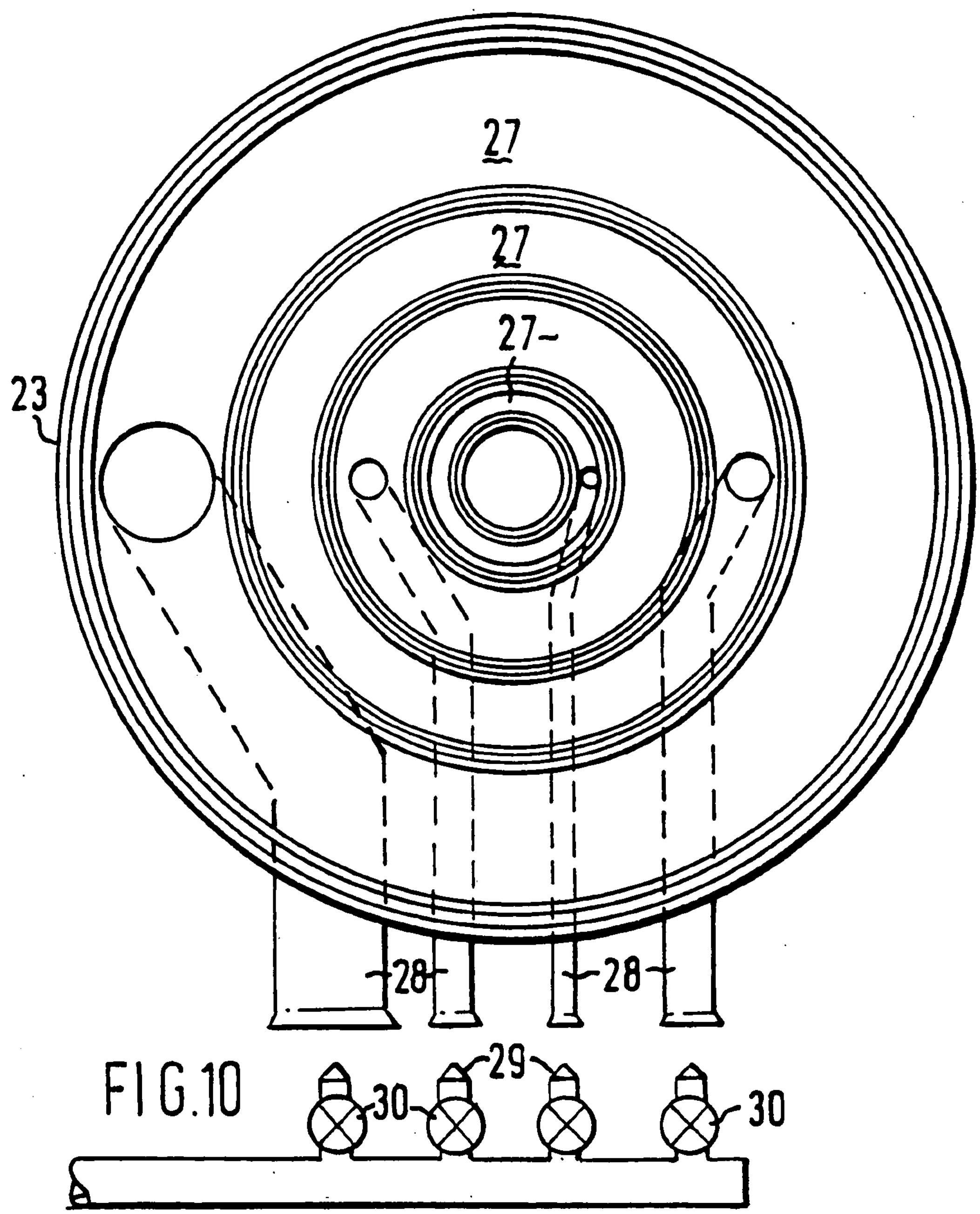

FIG.10

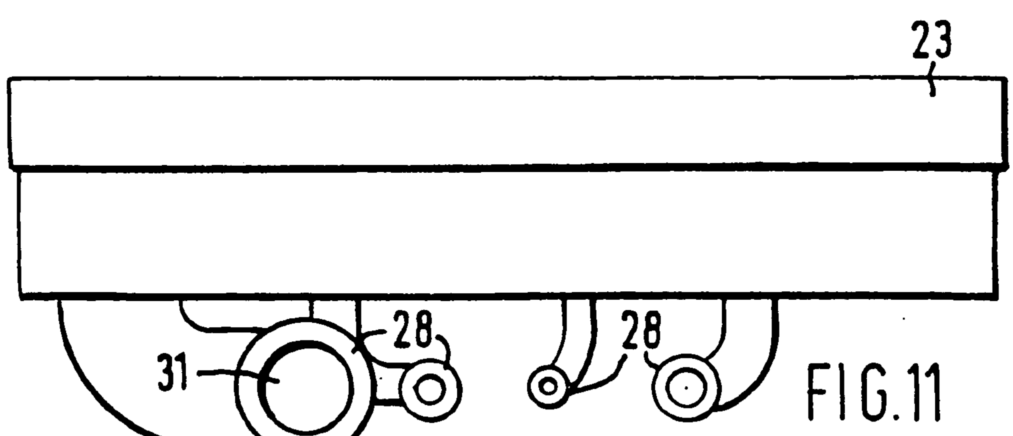

FIG.11

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 30 8731

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-B-1 116 615 (SOCIETE FRANCAISE D'INCANDESCENCE PAR LE GAZ SYSTEME AUER) * Column 1, lines 1-4,40-52; column 2, lines 1-43; column 3, lines 19-26,33-36; figures 1-3 *	1-3,10,11	F 23 D 14/14 F 24 C 15/24 F 24 C 3/08
Y		4-8	

Y	US-A-4 340 357 (KITO) * Column 1, lines 33-51; column 1, line 60 - column 2, line 31; figures 1-4 *	4	

Y	GB-A- 926 966 (OATLEY) * Page 1, lines 71-90; figures 1-4 *	5	TECHNICAL FIELDS SEARCHED (Int. Cl.4)

Y	DE-C- 412 163 (BURG) * Whole document *	6	F 23 D F 24 C

Y	GB-A-1 102 105 (PROEKTNY INSTITUT) * Page 1, line 61 - page 2, line 11; figure *	7,8	

A	US-A-3 291 188 (PARTIOT) * Column 4, lines 6-37; figures 4-6 *	1,3,4	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-02-1987	PHOA Y.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 30 8731

DOCUMENTS CONSIDERED TO BE RELEVANT			Page 2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	FR-A-1 408 445 (OSAKA) * Page 2, right-hand column, paragraph 4; figures 5,6 * ---	1,4	
A	US-A-2 677 366 (WYATT) * Column 1, line 50 - column 2, line 4; figures 1-3 * ---	5	
A	GB-A-1 328 899 (SAGARDUI) * Page 1, lines 24-36; page 1, line 54 - page 2, line 6; figures 1-10 * ---	7	
A	GB-A-2 010 472 (TENNANT) ---		
A	DE-A-2 633 849 (SCHWANK) -----		TECHNICAL FIELDS SEARCHED (Int. Cl.4)

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& : member of the same patent family, corresponding document

PUB-NO: EP000226324A1

DOCUMENT-IDENTIFIER: EP 226324 A1

TITLE: Surface combustion radiant.

PUBN-DATE: June 24, 1987

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APPL-NO: EP86308731

APPL-DATE: November 10, 1986

PRIORITY-DATA: GB08527595A (November 8, 1985) , GB08620606A (August 26, 1986)

INT-CL (IPC): F23D014/14, F24C003/08 , F24C015/24

EUR-CL (EPC): F23D014/14 ; F24C003/08, F24C015/24

US-CL-CURRENT: 431/326

ABSTRACT:

CHG DATE=19990617 STATUS=O> A radiant (1), for a self-aerating burner, having a multiplicity of ports (12) passing gas/air mixture for combustion at the surface of the radiant, wherein the ports are provided in discrete areas (11) that alternate with raised non-ported bars (10) with angled flanks which in use receive impingement of flame, giving visible radiation from the flanks but not the tops of the bars.